Granville Solvents Inc. Site, Granville, Ohio

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Removal Actions Completion Draft Final Report

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

1. INTRODUCTION

On September 7, 1994, the Granville Solvents PRP Group (the Group) entered into an Administrative Order on Consent (AOC) with the US Environmental Protection Agency (US EPA) to perform a number of Removal Actions outlined in the Order. This report summarizes the work completed, consistent with that Order, to protect the Village of Granville drinking water supply; to reduce the concentration of contaminants in groundwater to or below Applicable or Relevant and Appropriate Requirements (ARARs); and, to reduce the concentration of contaminants in site soils to no further action levels.

2. SITE CHARACTERIZATION

2.1 SITE DESCRIPTION

2.1.1 Site Location - Granville Solvents Site was an inactive waste solvent blending and recycling operation located at 300 Palmer Lane in Granville, Licking County, Ohio (Figure 2.1). The Site is near the southern corporate limit of the Village of Granville, located approximately 1/3 of one mile southeast of downtown Granville. The Site sits on a 1.5 acre triangular-shaped parcel located adjacent to a residential area with some commercial and light industrial businesses nearby. The Site is bordered on the northwest by Palmer Lane which slopes downward southwest toward the municipal well field. A former railroad track, now a bike and walking path, runs along the southern edge of the Site, with the Cherry Street overpass bordering the Site on the east. Raccoon Creek is located 100 feet south of the walking and bike path. Granville Village's municipal well field is located 700 feet west of the site (Figure 2.1). The Site is zoned for commercial use.

2.1.2 Site Geology –The Site is located on alluvial terrace deposits at the northern edge of Raccoon Creek Valley. The southern portion of the Site is within the 100 year floodplain of Raccoon Creek. Raccoon Creek Valley was cut by pre-glacial streams and modified by erosion and deposition during glacial periods. The valley is filled in places with more than 200 feet of unconsolidated sediment deposited primarily by glacial melt waters from the last glacial event which occurred approximately 12,000 years ago.

The site is directly underlain by clay-, silt-, and sand-rich sediments deposited on the Raccoon Creek floodplain. A highly permeable sand and gravel outwash is located below the surficial material. The finer grained surficial materials may retard, but do not form a hydraulic barrier to infiltration of precipitation from the surface. Well logs of the three Village of Granville production wells (PW-1, PW-2, and PW-3) and four exploratory borings located some 700 – 1,600 feet west of the western boundary of the Site indicate a thickness of at least 175 feet of sand and gravel outwash. Village wells PW-1 and PW-2 are screened from 72 – 95 feet below the surface; whereas, PW-3 is screened from 83 – 109 feet below the surface. PW-4, a production well installed in response to the terms of the AOC between the Group.

US EPA, is screened between 65 – 85 feet below the surface. Based on well logs of the production wells and site monitoring wells, a typical section may be simplified as a low permeability unit of inter-bedded fine-grained sand, silt, and clay lenses from the ground surface down to the water table (approximately 20 feet below the surface, typically at 900 amsl). The aquifer consists of fine-to coarse-grained silt and sand, inter-bedded with gravel lenses of various thicknesses beneath the water table.

Bedrock in the Valley and beneath surrounding uplands consists of sandstone, siltstone, and shale with minor conglomerate units. A bedrock ridge that extends from the adjacent Sugarloaf Hill underlies the Site.

2.1.3 Site Hydrogeology – The Raccoon Creek Valley contains a highly productive buried-valley aquifer. The Village of Granville produces nearly 750,000 gallons of water a day, usually from one of three water production wells. The production wells range in depth from 72 – 109 feet. Wells PW-1 and PW-2 were generally pumped for several hours a day at 650 -750 gallons per minute (gpm). Prior to its abandonment and replacement, PW-1 yielded less water and was generally pumped at a rate of 450 gpm. A new well, PW-4, was installed by the Group as a condition of the AOC as a replacement for PW-1. Production rates of 750,000 gallons per day are currently met by pumping wells PW-2, PW-3, and PW-4.

Raccoon Creek generally flows eastward in the vicinity of the Site and ultimately discharges into the Licking River. Before the Granville Village wells were installed, it is believed that groundwater flow at the Site was from the northern upland towards the creek, with a general down-valley component of flow to the east, typical of aquifers in similar buried valleys in central Ohio. Pumping Village wells has changed groundwater gradients by capturing groundwater that once was discharged to Raccoon Creek and inducing lateral flow from the Site and other parts of the aquifer recharge area. Groundwater gradients are low, with only a few tenths of a foot difference in elevation across the Site. Potentiometric data *(Monitoring Well Installation Report, December 1996)* and surface water elevations suggest that groundwater just north of Raccoon Creek and adjacent to the Site migrates south and north depending on pumping rates of the production wells in the Village of Granville municipal well field. If the surface water elevation is considered, there is a potential for water to flow both into and out of Raccoon Creek. Throughout the area of the Site, the stream appears to be a losing stream based on water levels.

The outwash-filled valley in the vicinity of the Village of Granville's production wells, and for several thousand feet east and west of the Site, is approximately 3,000 feet wide. Direct percolation of rainfall may account for as much as 8 – 10 inches annually including runoff from the adjacent hills, plus down-valley underflow and a small increment from the bedrock on the sides of the buried valley, and could account for all or most of the water removed annually from the aquifer due to pumping of the Village wells.

Transmissivity of the Raccoon Creek Valley aquifer is estimated to be in the range of 200,00 gallons per day per foot(gpd/ft) based on aquifer pumping tests conducted at the site in 1995 *(Aquifer Pumping Test Report, 1995)*. The saturated aquifer thickness is believed to be at least 100 feet beneath the Site and perhaps as thick as 200 feet in the area of the Village well field. For a thickness of 100 feet, the hydraulic conductivity has been estimated to be 2,000 gpd/ft^2.

2.2 SITE HISTORY

2.2.1 General Site Operations - Granville Solvents, Inc. (GSI) began operations in 1953 as a petroleum bulk storage, distribution, and recycling center in Granville, Ohio (Licking County). The Company moved to 300 Palmer Lane in 1958 and handled aviation fuels, antifreeze, and, later, petroleum solvents, purchasing bulk chemicals for repackaging and distribution. In 1980 or earlier, GSI ceased handling petroleum-related products and began operating as a solvents reclamation and recycling business. Beginning in 1980, GSI operated under an Interim RCRA Part A permit issued by the Ohio Environmental Protection Agency (OEPA). From 1980-1986, diverse solvents were processed.

On site storage facilities included fifteen (15) aboveground and underground steel storage tanks. Waste solvents were brought to GSI in bulk and drum quantities where they were stored. Solid residues were separated for disposal and solvents were distilled and collected for reuse. During this period, OEPA conducted and documented routine inspections of the facility.

In 1986, GSI was ordered by the Licking County Court of Common Pleas to cease operations and in 1990 and 1991, OEPA removed all storage tanks and drums and installed 15 groundwater monitoring wells. Between 1991 and 1994, OEPA periodically sampled groundwater from a number of the monitoring wells and chlorinated and non-chlorinated Volatile Organic Compounds (VOCs) were detected in groundwater samples collected from both on-site and off-site monitoring wells. In late 1993, chlorinated VOCs were detected in groundwater samples collected from monitoring well MW-8 located less than 400 feet east of one of the Village of Granville's water supply wells (PW-1). In early 1994, the Village of Granville, in response to a request from OEPA, removed water supply well PW-1 from service to reduce the likelihood of hydraulic capture of impacted groundwater in other water supply wells.

In early 1994, the US EPA identified a number of companies and individuals as Potentially Responsible Parties or PRPs who had allegedly shipped or arranged for the shipment of hazardous waste or materials to the GSI facility for recycling. A group of the PRPs voluntarily formed the Granville Solvents PRP Group (the Group) in February 1994 to negotiate the terms and conditions of an AOC between the Group and the US EPA. The current AOC, pursuant to Section 106 of CERCLA, was signed and issued on September 7, 1994.

2.2.2 State-led Interim Removal Actions – The OEPA conducted a state-led interim action in 1990 that included (1) characterization and removal of all known containerized waste, (2) excavation, cleaning, and removal of on-site storage tanks, (3) the installation of monitoring wells, and (4) sampling and analysis of on-site soils. Initially four groundwater monitoring wells were installed (MW-1, MW-2, MW-3 and MW-4D). Compliance Solutions, on behalf of OEPA, decontaminated the warehouse, employee lounge, and steel shed housing an air compressor; disposed of all wastewater; backfilled the

tank excavation pits; and completed Site restoration. In addition, Compliance Solutions installed an additional 10 monitoring wells (MW-2D, MW-4D2, MW-5, MW-6, MW-6D, MW-7, MW-7D, MW-8, MW-8D, and MW-P1) around the warehouse and downgradient of the site to determine the extent of migration of contaminants, characterize hydrogeologic conditions at the Site, and to monitor potential migration of groundwater contamination. Chlorinated VOCs that were most frequently detected at the highest concentrations in groundwater samples included tetrachloroethene (PCE); 1,1,1-trichoroethane (1,1,1-TCA); trichloroethene (TCE); 1,1-dichloroethane (1,1-DCA); 1,1-dichloroethene (1,1-DCE); and, cis-1,2- DCE.

Groundwater samples collected during seven events conducted by OEPA from 1990 – 1993 contained acetone, bromodichloromethane, chloroform, cis-1,2-DCE, dibromochloromethane, PCE, toluene, xylene, trans-1,2-DCE, TCE, vinyl chloride (VC), 1,1-DCA, 1,1,1-TCA, and 1,2,4-trichorobenzene. Groundwater samples were also analyzed for Semi-Volatile Organic Compounds (SVOCs), pesticides, and polychlorinated biphenyls (PCBs); however none were detected.

Surface and subsurface soil samples were collected as a part of OEPA's investigation during the installation of groundwater monitoring wells MW-2D, MW-D2, MW-6D, MW-8, MW-8D, and MW-P1 and analyzed for VOCs. Generally, samples collected between 20 and 40 feet below ground surface contained the highest concentrations of VOCs. Samples collected at MW-2D and MW-4D contained the highest concentrations and, with the exception of samples collected at MW-P1, surface samples contained relatively low concentrations of VOCs. Contaminants detected included benzene, ethylbenzene, cis-1,2-DCE, methylene chloride, PCE, toluene, xylene, styrene, TCE, 1,1-DCE, 1,1-DCA, and 1,1,1-TCA.

3. ADMINISTRATIVE ORDER ON CONSENT

On September 7, 1994, the Group entered into an AOC with the US EPA to perform a number of Removal Actions outlined in the Order. Work to be completed included the following:

1. Develop and implement a site security plan.

2. Develop and implement an air monitoring program, if and to the extent required by federal and state ARARs, during site activities

3. Develop and implement a comprehensive sampling and analysis plan to characterize the nature and extent of all contamination at and originating from the Site.

4. Develop and implement a groundwater monitoring and testing plan for the purpose of monitoring and assessing the threat of contamination (originating from the Site) entering the Village of Granville municipal well field water supply.

5. By December 20, 1994:
    a. Install and run a groundwater extraction and treatment system which shall halt the migration of groundwater contamination (originating from the Site) toward the Village of Granville municipal well field. Treat and discharge all extracted water as required by the Work Plan and this Order. Respondents shall propose treatment and discharge requirements in the draft Work Plan. Continue to run said system, and monitor performance , until the extraction and treatment system specified in subsection 2.f, infra, is fully operational. Satisfying the requirements of this subsection, 2.e.1 is not conditioned on the issuance of an OEPA permit; however, Respondents are required to meet all treatment and discharge standards.

    b. In addition, implement action which is necessary to ensure that any water contaminated with any contamination (originating from the Site) that enters the Village of Granville municipal drinking water supply meets all risk-based and all applicable federal and state drinking water standards. Such action may include utilization of, modification of, and/or addition to the Village of Granville municipal well field drinking water supply system, including its water treatment system. (For example, such action may be, or include, wellhead treatment which meets the performance standards of this Order; or, may be, or include, the installation of an appropriate alternative water supply). Such action shall be implemented at the Village of Granville municipal well field to the extent necessary both to reinstate fully the capacity of the PW-1 prior to is reactivation and to the extent necessary to prevent loss in the Village of Granville municipal well field drinking water supply capacity (i.e., the collective capacity of PW-1, PW-2, and PW-3) caused , in whole or in part, because of contamination (originating from the Site), or the threat thereof, entering the Village of Granville municipal well field water supply

6. Design, install, and operate a groundwater extraction and treatment system which shall halt the migration of groundwater contamination (originating from the Site) toward the Village of Granville municipal well field and shall treat all groundwater within the contamination plume originating from the Site to no further action levels which will assure protection of human health and the environment and attain all risk-based standards and federal and state ARARs.

7. Treat soils at the Site to levels which will assure protection of human health and the environment, to levels which will attain all risk-based standards and federal and state ARARs, and to levels which will assure, to the maximum extent practicable, that no groundwater beneath the soils will become contaminated above the groundwater no further action levels. Respondents shall propose a schedule to develop soil treatments objectives, no further action levels, performance monitoring parameters, and a plan for treatment of the soils, in the draft Work Plan.

4. COMPLETION OF REMOVAL ACTIONS

The Order requires completion of certain Removal Actions that include (1) the installation of a groundwater extraction and treatment system to halt the migration of contaminated groundwater toward the Granville Village municipal well field and to reduce the concentration of contaminants in groundwater; (2) reinstating the capacity of the Village's groundwater production; and (3) reducing the levels of contaminants in soils on site so that the groundwater beneath the soils will not become contaminated above groundwater "no further action" levels.

4.1 Installation of a Groundwater Extraction and Treatment System.

A groundwater pump and treat system for the Site was designed, constructed, and placed into service on December 20, 1994. Installation and system start-up is described in *the Aquifer Pumping Test Report (M&E, 1995)* submitted to US EPA on January 31, 1995. Evaluation of the pump and treat performance was summarized in the *Treatability Performance Report (M&E, 1995)* submitted to US EPA on July 19 1995 and operation and maintenance of the system was described in the *Operation and Maintenance Manual (M&E, 1995)* prepared in April 1995 and revised in April 2001.

The groundwater pump and treat system consisted of two extraction wells, EW-1 and EW-2. EW-1 was installed some 600 feet west of the Site to capture contaminated groundwater and halt its migration to the Granville Village municipal well field. PW-2 was installed at the Site in groundwater containing the highest concentration of contaminants to enhance treatment and removal effectiveness. Groundwater extracted from these wells was pumped to a shallow tray aeration system in a treatment building where VOCs in the groundwater were transferred to the air which was discharged to the atmosphere. Treated groundwater was discharged to Raccoon Creek. The extracted groundwater was operated continuously from December 1994 through March 2005. The system was operated for 98.5 percent of the time and successfully maintained capture of impacted groundwater and protected the Village of Granville municipal well field. The system, on average, removed 7.0 – 8.0 pounds of VOCs per month and successfully reduced the concentration of contaminants in the extracted groundwater to levels below the discharge criteria through the entire period of operation.

Table 4.1 contains a summary of the system operation, including average pumping rates, VOC mass loading rates, hours of system operation, and operational percentages by month. Pumping rates for the system are shown in Figure 4-1. Average monthly pumping rates varied from 150 gallons per minute (gpm) to 320 gpm. Average daily VOC removal rates following treatment are plotted in Figure 4-2.

Influent and effluent concentrations were monitored monthly for the pump-and-treat system as part of the requirements for the NPDES permit waiver for effluent discharge to Raccoon Creek. Concentrations of specific VOCs in influent and effluent groundwater are listed in Table 4.2 and the influent concentrations of primary VOCs is plotted in Figure 4.3, whereas, the concentration of primary VOCs in the system effluent are plotted in Figure 4.4.

The groundwater pump and treat system operated continuously for more than seven years. During that time, the system extracted, treated, and discharged more than 900 million gallons of groundwater. The

system removed an average of 7.8 pounds of VOCs per month for a total of 686 pounds of VOCs over the seven years of operation. The system successfully treated extracted groundwater to levels below the discharge criteria through the full period of operation.

4.2 Hydraulic Capture of Impacted Groundwater

A primary purpose of the groundwater pump and treat system was to capture groundwater that had been impacted with VOCs thereby preventing the migration of contaminants to the Village of Granville well field. Groundwater levels in both on-site and off-site piezometers and monitoring wells were measured monthly since the start-up of the pump and treat system. Water level data that was collected from 1994 to 2002 are listed in Appendix A.

A potentiometric surface of the aquifer was plotted each month to verify that the system was capturing impacted groundwater and preventing migration of impacted groundwater to the village well field. In addition, the data was used to identify locations of groundwater divides between the primary pumping centers (the village well field and EW-1 and EW-2). A cone of depression around the pump and treatment wells, EW-1 and EW-2, was observed. Variability in the size and shape of the cone of depression from month to month was attributed to varying pumping rates of wells in the village well field. Although the location of the groundwater divide varied from month to month, capture of impacted groundwater by the pump and treatment wells was always observed.

Potentiometric surfaces variability maps are included in Appendix B. Although the shapes and areas of capture vary between each mapped surface, the capture of impacted groundwater by the Site wells is illustrated in each figure.

During the seven years of operation, the system extracted and treated groundwater for 98.5% of the total time, and succeeded in hydraulic control of the groundwater VOC plume observed at the Site.

4.3 Restoration of the Village of Granville's Well Field Capacity.

Village production well PW-4 was installed in the Village well field in 1997 to replace the production capacity of PW-1.

4.4 Groundwater Monitoring.

A network of groundwater monitoring wells were installed and monitored on a routine basis to: (1) verify that the groundwater extraction and treatment system was effectively capturing contaminated groundwater and (2) evaluate the size and location of the impacted plume of groundwater. A regular sampling program was implemented using a number of EPA-installed wells and wells installed by the Group to detect changes in plume configuration and concentration. Details of the monitoring network for the Site are available in two reports: *Removal Action Groundwater Monitoring Program Plan* (Metcalf & Eddy, 1995) and *Monitoring Well Installation Report* (Metcalf & Eddy, 1996). Locations of various monitoring wells are shown in Figure 4.5. Wells included in the monitoring program and the sampling frequencies are listed in Table 4-3. Annual monitoring occurred in May of each year, semiannual in

November, and quarterly in August and February. Details on screen elevations and locations of each well are listed in Table 4-4.

Groundwater monitoring was initiated in May 1996 when wells were sampled and analyzed for a number of VOCs. Tables containing groundwater monitoring data obtained between 1991 and 1996 prior to implementing the full monitoring program can be found in Appendix C. Data collected from quarterly, semiannual, and annual sampling conducted after 1996 through 2002 are listed in Appendix D. Concentration contours of the primary constituents of concern have been plotted. Concentration contours of PCE in groundwater samples collected in 1996, 1997, 1998, 2000, and 2001 are shown in Figures 4-6 through 4-11. Similar contours for the same time period for TCE can be found in Figures 4-12 through 4-18; whereas, contours of the concentrations of 1,1,1-TCA for the same time are shown in Figures 4-19 through 4-25.

Changes in the concentration of compounds in samples collected between 1996 and 2001 are shown in Figures 4-26 and 4-29. The concentration of PCE (Figure 4-26) generally decreased in all wells with the exception of well MW-4D when a significant increase was observed in the sample collected in May 2001. TCE concentrations (Figure 4-27) declined in wells MW-P1 and MW-2D over the period, but had otherwise remained stable in samples collected from other monitoring wells. The concentration of 1,1,1-TCA (Figure 4-28) in the sampled wells declined over time with the exception of an unexpected spike in concentration in GSS MW-6 in May 1997. Measurable concentrations of cis-1,2,-DCE (Figure 4-29) were detected in monitoring wells MW-2D, MW-4D, and MW-8 over the sampling period. In general, the concentration of cis-1,2-DCE declined over time in both MW-2D and MW-4D; however, it fluctuated considerably in MW-8, ranging from a low near 0 in May 1996, February 1998, November 1999, and February 2001 to a high of near 100 ppb in May 2000. The concentration of cis-1,2-DCE in monitoring well MW-08 exceeded the US EPA Maximum Contaminant Level (MCL) of 70 ppb at least 5 times between 1996 and 2001.

The groundwater quality data from monitoring wells including several wells which contained no detectable amounts of the contaminants measured (i.e., GSSMW1, GSSMW3, GSSMW4, GSSMW6, GSSMW8D, GSSMW9, GSSMW12, GSSMW13, and GSSMW14) verified that impacted groundwater was contained and not migrating toward the village well field.

The groundwater monitoring program verified that migration of constituents of concern toward the village well field was not occurring. Concentration contour plots (Figures 31-33) for the constituents of concern demonstrated that, in general, the extent of contamination in the groundwater (the plume) decreased in the cases of PCE, TCE, and 1,1,1-TCA during the time that the groundwater treatment system and soil treatment system were operated. However, fluctuations of contaminants were observed in some source area wells (MW-4D and MW-2D) and, in some instances increasing concentrations were noted, though not on a continuous basis.

4.5 Source Area Soil Treatment

In December 1995, a Design Technical Memorandum for the *Remediation of Impacted Soils* (Design Technical Memorandum) approved by US EPA outlined an investigation to obtain data for the selection and design of a remedial solution for contaminated soils. The investigation was implemented during the Spring of 1996, and data were evaluated and forwarded to US EPA in the *Soil Data Report* dated September 1996 and revised in December 1996. In December 1996, a groundwater flow model and contaminant fate and transport model were developed to aid in the determination of soil treatments requirements. The results of that study were forwarded to US EPA (Groundwater Flow and Contaminant Fate and Transport Model Report 1996, revised in 1998) and were used to evaluate the level of source area soil treatment required.

Based on the outcome of the groundwater flow and contaminant fate and transport model, the Group developed and then submitted in August 1999 *an Engineering Evaluation and Cost Analysis (EE/CA)for the Treatment for Impacted Soils at the Granville Solvents Site.* That document included a streamlined risk evaluation that defined soil treatment goals for both chlorinated and non-chlorinated VOCs in soil that would not pose an unacceptable risk to individuals who might directly contact the soils. As specified in the EE/CA, soil treatment criteria were established for several VOCs (Table 4.5) and only TCE and PCE initially exceeded their treatment goals of 6.67 mg/kg and 5.53 mg/kg, respectively. The above clean-up goals were approved by US EPA in October 1999 (US EPA letter to Ben Pfefferle, III from Sirtaj Ahmed, October 14, 1999) and placed into the administrative record by reference in March, 2000 (US EPA Enforcement Action Memorandum, March 8, 2000).

A soil treatment system consisting of soil vapor extraction, air injection, and air sparging in the saturated zone underneath the source area, was installed in December 2001 and operated through March 2005. VOC removal was routinely monitored by periodically collecting and analyzing off-gases from the SVE system in summa canisters. Based on soil sampling data collected in May 1996 (Table 4.5) a total of 85 pounds of TCE and 110 pounds of PCE were present in source area soils requiring treatment (TCE and PCE were the only chemicals of concern that exceeded US EPA approved removal action criteria- US EPA Enforcement Action Memorandum, March 8, 2000). Concentrations of SVE off gases collected in summa canisters in June 2004 when compared to similar samples collected in December 2001 (Table 4.6) indicated that approximately 334 pounds of VOCs had been removed by the SVE system since start-up.

The above data demonstrates that soil treatment goals have been achieved. Approximately 125 pounds of TCE and 184 pounds of PCE have been removed. Based on this data, soils beneath the Site have been treated to required levels established in the approved Engineering Evaluation/Cost Analysis (EE/CA) such that groundwater beneath the soils will not be contaminated above the "no further action" levels.

5. TREATMENT SUSPENSION AND GROUNDWATER QUALITY MONITORING

Based on groundwater quality and soil data collected at the Site since May 1996, the Group suspected that the contaminant concentrations underneath the Site had stabilized to the extent that the plume may no longer pose a threat to the village well field absent additional treatment. The Group submitted a proposal to US EPA to suspend treatment of both groundwater and soil and monitor groundwater quality in selected wells over the next 5 years to determine if contaminant levels had stabilized to a point wherein there was little or no threat of contaminating groundwater in the village well field. US EPA approved the proposal and groundwater and soil treatment were suspended in March 2005. A number of monitoring wells were selected at the source of contamination (source area wells), at an intermediate distance downstream of the source area (leading edge wells) and at or near the village well field as compliance wells. An additional well (GSS-MW-15) was installed between the source area wells and the leading edge wells to help detect the reformation of a plume before it reached the leading edge wells.

5.1 New Groundwater Monitoring Well

Monitoring well GSS-MW-15 was installed on September 6, 2005 some 300 feet downgradient from the source area. GSS-MW-15 was constructed with 2-inch PVC to a depth of 34 feet below ground surface with a screen interval from 896.07 feet to 886.07 feet (24 to 34 feet below existing ground surface). The screen interval was based on split spoon samples collected during boring installation. One 2 foot sample was collected every five feet from ground surface to 22 feet below ground surface. Samples were collected continuously from 20 feet to 34 feet. Groundwater was first encountered below a semi-confining unit noticed in the sample collected from 24 to 26 feet. The semi-confining unit consisted of alternating layers of silty sand and gravel, silty clay, and cobble. The well log and drilling report are included in Appendix D.

GSS-MW-15 was developed and then sampled using a 12-volt submersible pump on September 8, 2005. The pump and hose were decontaminated internally and externally with potable water, Liquinox, and rinsed with de-ionized water prior to placement in the well. An equipment blank was collected from the pump following decontamination. Well development consisted of surging and pumping the well continuously until field parameters, including pH, conductivity, dissolved oxygen, and oxidation-reduction potential, had stabilized and turbidity was less than 5 NTU.

5.2 Potentiometric Surface Determinations

Potentiometric surface elevations were routinely measured from August 2005 to September 2009 to evaluate groundwater flow direction. Water table levels measured between August 2005 and September 2009 are listed in Table 5.1 – Table 5.5 and potentiometric surface maps from August 2005 through September 2009 can be found in Appendix E.

In general, groundwater flow following suspension of treatment has been to the South towards Raccoon Creek. The latest potentiometric surfaces measured in September 2009 were similar to others in that

groundwater flow was still towards Raccoon Creek. In addition, the March 2009 map indicated that a subtle groundwater divide separates the Site from the village well field due to pumping at the water treatment plant. This groundwater divide supports the conclusion that the residual groundwater plume from the Site is not nor will not affect the village well field in the absence of groundwater extraction. Site VOC plume data tends to support this idea, with the exception of VOC increases in wells GSSMW-15, MW-2D, and MW-8, which suggest a potential western shift of the plume. However, the observed increases may be due to dispersion overriding the low gradients at the Site, stratigraphic variation in deposition controlling lateral plume movements, or the transient nature of the local groundwater flow during periods when Raccoon Creek changes from a gaining to a losing stream.

5.3 Groundwater Quality Monitoring –

Beginning in March 2005, the groundwater quality monitoring program was modified to include selected existing wells and the new well, GSSMW-15, installed in September 2005. Monitoring wells MW-2D, MW-4D, MW-6, and MW-P1 were designated to be "source area wells" because data collected from those wells would represent contaminant concentrations and changes in concentrations in the contaminant source area. Wells MW-8 and MW-7 were the designated "leading edge" wells to help track and detect the leading edge of plumes migrating from the source area towards the village well field and wells GSSMW-8 and GSSMW-9 were compliance area wells located in the "compliance zone" near the Village of Granville's production well PW-1. Wells were sampled at the frequencies specified below between August 2005 and September 2009:

MONITORING WELL	SAMPLING FREQUENCY
MW-2D	Semi-annually
MW-4D	Semi-annually
MW-6	Semi-annually
MW-P1	Semi-annually
MW-7D	Semi-annually
MW-8	Semi-annually
GSSMW-8	Semi-annually
GSSMW-9	Semi-annually
GSSMW-15	Semi-annually
GSSEW-01	Annually

Monitoring wells were sampled at the following times over the past 5 years:

- August 2005
- May 2006
- July 2006
- May 2007 (annual)
- September 2007
- April 2008 (annual)
- September 2008

- March 2009 (annual)
- September 2009

Groundwater quality data collected over the 5 year period after treatment was suspended are included in Appendix F. Plume maps are included in Appendix G. The principal contaminants that have been detected in measurable quantities in all monitoring wells with the exception of GSSMW-8, and GSSMW-9 (the compliance wells) include 1,1,1-TCA, cis-1,2-DCE, trans-1,2-DCE, PCE, and TCE. Measured levels of 1,1,1-TCA, PCE, TCE, and cis-1,2-DCE observed in source area wells MW-4D (Figure 5-1), MW-P1 (figure 5.2), and MW-6 (Figure 5.3) have remained similar to concentrations observed in those wells prior to suspending groundwater and soil treatment in March 2005. However, there has been a measurable increase in the concentration of 1,1,1-TCA, PCE, and TCE observed in MW-2D (Figure 5.4) since treatment was suspended.

Since samples were first collected from monitoring well GSSMW-15 in August 2005, the concentrations of PCE, TCE, 1,1,1-TCA and cis-1,2-DCE observed have increased, and in the case of TCE and PCE above their respective MCLs, over the sampling period (Figure 5-5). None of the compounds of interest, with the exception of an unexplained spike in PCE observed in April 2007, have been detected in MW-7 (figure 5-6) since treat was suspended. The only compound of concern observed in MW-8 has been cis-1,2-DCE which has ranged between 22 ug/l to a little more than 70 ug/l, the MCL for that compound (Figure 5-7). Compounds of interest have not been detected in either compliance (GSSMW-8 and GSSMW-9) (Figures 5.8 and 5.9) before or after suspending groundwater and soil treatment, with the exception of detectable amounts of TCE in samples collected from GSSMW-9 in August 2008 and March 2009.

Data on groundwater quality collected since suspending groundwater and soil treatment indicates that the concentration of VOCs observed in both the compliance area wells and the leading edge wells has remained relatively stable and below the respective MCLs for the compounds monitored. However, it does appear that a localized TCE and PCE "rebound plume" extends from MW-2D in the source area to GSSMW-15. Yet there is no evidence that the plume extends out to MW-8 or MW-7. Potentiometric data suggests that a groundwater divide that would retard the migration of a plume exists between the Site and the Granville Village Well Field, absent of any groundwater extraction on the site.

6. SUMMARY OF REMOVAL ACTION COSTS AND MATERIALS REMOVED OFF SITE

6.1 Budget Summary –

Estimated costs to complete all removal actions are listed in Table 6.1. Just over $7,000,000 was invested in engineering and technical services, while $1,000,000 in response fees to US EPA and $63,000 in site management costs.

6.2 Materials Removed Off Site -

Most of the materials used in the operation of the Granville Solvents Site were removed prior to the Group entering into the AOC and participating in the Removal Action. As noted in Section 2.2.2 of this report. OEPA removed all known containerized waste; on-site storage tanks, and wastewater generated on site.

The Group shipped small quantities of hazardous wastes generated on site to Wayne Disposal, Inc. owned at the time by EQ, Inc for proper disposal in 2001. The waste generally consisted of small quantities of septic debris (F002), miscellaneous debris (F003) and bag filters (F002) from the water treatment process. Specific manifests for the waste shipments were not in the existing records, but a 2001 Annual Hazardous Waste Report submitted to OEPA and an LDR Certification Form dated October 10, 2000 has been placed in Appendix I of this report.

7. CONCLUSIONS AND RECOMMENDATIONS

Conclusions –

The following conclusions are based on more than 10 years of groundwater treatment and source area soils and 5 years of monitoring groundwater quality at and beyond the Site:

1. The groundwater extraction and treatment system that was installed and started operation in December 1994 halted migration of groundwater contamination from the Site and reduced the mass and size of the groundwater contamination plume to the extent that groundwater treatment has been suspended over the past 5 years while still meeting the obligations established in the AOC.

2. Village production well PW-4 was installed in the village well field to reinstate the capacity of production well PW-1.

3. A soil treatment system was installed and operated from 2001 to 2005. Concentrations of contaminants (19 chemicals of concern identified in the approved Engineering Evaluation/Cost Analysis (EE/CA)) in soils beneath the Site have been reduced to the extent that (a) groundwater in the compliance zone will not exceed MCLs and (b) groundwater beneath the Site will not become contaminated above the no further action levels defined in the EE/CA.

4. Contaminants monitored in groundwater following suspension of both groundwater and soil treatment in March 2005 have stabilized to the extent that increases in TCE and PCE have been observed in only two wells (MW-2D and GSSMW-15) in the past 5 years. Both the TCE and PCE plumes appear to be "rebound plumes" generated after treatment suspension and do not pose a threat to the village well field at this time. The latest groundwater data collected suggests that

a groundwater divide exists at the Site that would retard or prevent the TCE/PCE plume from impacting the village well field.

The Group has achieved the cleanup criteria in groundwater at the compliance zone, in the groundwater beneath the Site, and in the soil in the source area. As a result the Group has addressed and completed all removal actions listed in the AOC.

Recommendations –

1. Based upon the work completed and the conclusion that the Group has now completed all removal actions listed in the AOC, the Group recommends that EPA, following its review of this summary report and the data herein, issue a Notice of Completion consistent with the terms and conditions outlined in Section XVII Notice of Completion of the AOC.

2. Consistent with Section V, paragraph 2.4, the Group will submit a proposal for post-removal site control that will include: (1) site security measures; (2) procedures and time frames to dismantle and remove site groundwater and soil treatment facilities; (3) a post-closure groundwater monitoring plan to assess the stabilization of the plume which will consist of annual sampling of a selected number of wells until plume stabilization is confirmed; (4) close selected groundwater wells which are no longer necessary; and, (5) deed restrictions on the property to prevent the use of groundwater under the Site and limit soil disturbance.

8. CERTIFICATION

Under penalty of law, I certify that, to the best of my knowledge, after appropriate inquiries of all relevant persons involved in the preparation of this report, the information submitted is true, accurate, and complete.

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William Brewer, Project Manager
Granville Solvents Site Response Management Group, LLC

Date: July 31, 2010